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RÉSUMÉ OF WORK OF THE NONMETALS DIVISION, CALENDAR YEAR 1936

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BY

OLIVER C. RALSTON AND A. GEORGE STERN

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DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

RÉSUMÉ OF WORK OF THE NONMETALS DIVISION,[1]

CALENDAR YEAR, 1936

By Oliver C. Ralston[2] and A. George Stern[3]

Nonmetallic technologic investigations of the U. S. Bureau of Mines are eadquartered at experiment stations in three widely separated localities f the United States. During 1936, the Nonmetals Division of the Technologic ranch was formally set up by combining the direction of the work of these hree experiment stations under one administration.

The New Brunswick (N.J.) station which in the past has been known as the onmetallic Minerals Experiment Station, is henceforth to be at College Park, d., as part of the Eastern Experiment Station, and its principal activities ill be related to the nonmetallic resources of the Eastern and New England tates.

The Southern Experiment Station at Tuscaloosa, Ala., has as one of its mportant functions the study of the nonmetallic resources of the South; and imilarly, the Northwestern Experiment Station, Seattle, Wash., investigates esources of a nonmetallic nature in the northwestern portion of the United tates. The Ore Testing section of the Metallurgical Division at Rolla, Mo., nd Reno, Nev., examines both metallurgical and nonmetallic ores. In each ase, however, the results of a particular investigation at a station are vailable and, in many cases, applicable to deposits throughout the United tates.

For convenience in classifying, the technologic investigations of the ureau on nonmetallic minerals have been arranged in the following groups:

1. Occurrence, composition, and properties.
2. Purification, preparation, and beneficiation.
3. Processing and utilization.
4. New facilities for new problems.

ost of the investigations are broader than the group in which they are placed, ut the grouping is justified by the emphasis of the work.

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I. OCCURRENCE, COMPOSITION AND PROPERTIES

Refractory and ceramic materials with varying characteristics are sought by many industries. At present, large quantities of these raw materials are imported and transported long distances. To assist industries using these commodities, several investigations are in progress to permit utilization of existing American deposits by improving their characteristics.

Silica Sands

Glass manufacturers on the Pacific coast now import most of the sand they use from Belgium. Likewise, a large portion of the foundry sand is imported. Previous studies on kaolins of the Pacific Northwest indicated that the sands washed from these kaolins might be suitable for glass manufacture.

To date, none of the sands examined were pure enough, in the original condition, for glass, although several were purified by removal of iron impurities by table and magnetic concentration. Glass-melting color tests indicate that they can be used in certain grades of the clearer glasses. At least one foundry has made successful commercial tests from rock deposits to replace imported sands or domestic material which must be transported great distances.[4]

Chromite

A domestic source of chrome is being sought. Several deposits are know to occur in the Pacific Northwest, and several of these are attracting attention of mining interests. Much of this chrome is now being imported, and it is expected that the investigation recently initiated by the Bureau will sho the way to use of these domestic chromite deposits for "shape" and "plastic" chrome refractories as well as encourage utilization of this refractory material in western metallurgical industries.

Olivine

Large quantities of refractory olivine rock have been found on Cypress Island in Puget Sound and vicinity. Olivine is the natural rock mixture of minerals forsterite ($2\ MgO.SiO_2$) and fayalite ($FeO.SiO_2$). It is more refrac tory than soapstone and talc and is much harder in the original state. Its refractory qualities should make it highly desirable for metallurgical purposes, and an investigation of the utilization of these northwestern dep is being continued.

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[4] Wilson, Hewitt, and Zvanut, F. J., The Properties of Quartz Sands Washe from Kaolins from the Pacific Northwest: Univ. of Washington Eng. Exp. Bull. 88, 1936, 42 pp.

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Soapstone

The extensive deposits of talc and soapstone in the Pacific Northwest e prompted investigations of their use for ceramic purposes. This study has n continued from the previous year and has shown that under certain condi- ns the talc may be added to portland cement for intermediate refractory k and to chrome cement for higher-temperature refractory purposes. A liminary report of this work has been published and the investigation will continued during the coming year to complete it.[5]

Pumice

Although the Bureau is conducting no work on pumice and pumicite at sent, considerable interest is being shown in these materials. The icosis scare and hysteria have prompted many abrasive users to seek sub- tutes for tripoli and other silicosis-producing abrasives. The United tes has an abundance of volcanic pumaceous minerals, of which pumicite mice powder) has long been recognized as an acceptable polishing powder. ever, the relative effectiveness of various grades suitable for many poses and the abrasive qualities of various deposits is not available. tle is known about the tendency of these minerals to produce silicosis, it is therefore a problem of Nation-wide importance that deserves the ention of the Bureau.

Spectrographic Analysis

The spectrograph, a new tool recently developed for analysis, offers apid and simple method of identifying and estimating minerals. In the t, however, quantitative determinations by the spectroscope have been lied mainly to metal fields, and those methods have not been applicable nonmetallic minerals. A modification of conventional practice has been e to permit estimates of the quantity of the components so that it will possible to estimate unknown substances with a reasonable degree of pre- ion. This investigation is just being started, and it is expected that desired increase in precision will take about 2 years' work. This uld cut the cost of analytical determinations in numerous industries and er a convenient tool for analytical use.

Cracking of Boiler Steel

Since "caustic embrittlement" has long been regarded as a cause of boiler- el cracking, numerous empirical preventatives have been suggested. The eau has now determined that this action does not take place unless certain nts of silica are also dissolved in the caustic boiler water.[6] This ing was of outstanding effect in helping explain previously puzzling

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ilson, Hewitt, and Pask, J. A., Talc and Soapstone in Washington. Am. Inst. Min. and Met. Eng. Contrib. 99, February 1936, 25 pp.

Schroeder, W. C., and Berk, A. A., Action of Solutions of Sodium Silicate and Sodium Hydroxide at 250°C. on Steel under Stress. Am. Inst. Min. and Met. Eng., Tech. Pub. 691, Metals Technology, January 1936, 14 pp.; February 1936, 14 pp.; Combustion, vol. 7, no. 8, February 1936, pp. 29-33.

Original from THE OHIO STATE UNIVERSITY

contradictions in boiler failures and helping to extend the study of mineral constituents of the water. Wide attention was given to these findings and enthusiastic cooperation from the Boiler Feedwater Studies Subcommittee of the American Society of Mechanical Engineers resulted. This subcommittee raised a 2 year fund by subscription to continue the highly promising lead reported last year, namely, that silica dissolved in a caustic boiler water is necessary to cause the steel to crack. Conditions for augmenting and for diminishing this cracking have been studied. Certain oxidizing agents inhibi it, especially the presence of sodium chromate. It has also been found that lignin and certain classes of tannins can inhibit this effect. On the other hand, not only sodium silicate in the caustic boiler water but also dissolve titanium oxide, germanium oxide, and antimony oxides have been found to contribute to cracking. The nature of the cracks has been definitely shown to be intercrystalline, and, in the case of caustic boiler water, cracks could only be produced in steel under stress. However, in a sodium nitrate solution it was found possible to bring about the same cracking on steel which was not under active stress but had merely been cold-worked. Sodium nitrate solutions, if pure, cause no such intercrystalline cracking, but if a tiny amount of soluble manganese salt is present, the steel actually falls apart in a few days. It took over 2 years to learn how to produce the cracking, and now that it can be produced at will very active research is in prog on a wide variety of ways to mitigate the trouble. Results to date indicate that caustic solutions alone do not embrittle steel. Although silica usuall is the troublesome component, it has been found that titanium dioxide will result in cracking under similar conditions.7, 8/ Important financial support for continuing this investigation has been made in the last year by the Association of American Railroads.

In connection with industrial water problems, additional investigation by the Bureau is highly desirable. Water is one of our most important minera The U. S. Geological Survey gages streams and analyzes the water. The U. S. Public Health Service and similar organizations look after biologic and toxi impurities. The U. S. Bureau of Mines should aid the mineral industries in the economic disposal of their wastes, which, if discharged into streams, would damage the water for domestic and industrial use. Among the problems that the Bureau should investigate are the reduction of acidity and mineral content of waters from mines and mills and the disposal of brines from oil fields. As a result of these investigations it might propose economic metho for controlling the nuisance at the source thereby avoiding the too rigorous public control that tends to drive industry away.

7/ Schroeder, W. C., and Partridge, E. P., Effect of Solutions on the Endur of Low-Carbon Steel under Repeated Torsion at 482°F.(250°C.): Joint Research Committee on Boiler Feedwater Studies Progress Report 7, reprinted from Am. Soc. Mech. Eng. Trans. for Apr. 1, 1936.

8/ Schroeder, W. C., Berl, A. A., and Gabriel, Alton, Jr., Solubility Equil of Sodium Sulphate at Temperatures from 150° to 350°C. II. Effect of Sodium Hydroxide and Sodium Carbonate: Am. Chem. Soc., vol. 58, 1936, p. 843.

II. PURIFICATION, PREPARATION, AND BENEFICIATION

Many nonmetallic mineral deposits are unsuited to commercial use unless fied. To render them of utility commercially, impurities must be removed the minerals treated to give them more desirable characteristics. This lves study of methods of purifying to determine the conditions of flotation, meration, magnetic or air separation most suitable, as well as investiga- of other special methods.

Lithium Minerals

An increasing demand for lithium compounds has been noted during the last years, yet the supply of the mineral heretofore used as the source of ium--amblygonite (a lithium alumino-phosphate)--is becoming increasingly rtain. When this mineral fails to meet the demand, spodumeme, a lithium ino-silicate of "feldspathoid" behavior which occurs in large amounts in h Dakota and North Carolina, may serve as the next most suitable source.

One of the most spectacular discoveries of the year is the finding by the au of Mines that this lithium feldspar, spodumene, in passing to its high erature or "beta" form, is so expanded and weakened that it can be rubbed to a powder and separated from gangue minerals by air separating or ening methods. This is true even on lumps of ore as large as one's head. ill permit concentration of low-grade ores not previously regarded as omic and provide a supply of cheap concentrate for the growing and pro- ng lithium chloride, lithium hydroxide, and lithium carbonate industry. a product is also expected to be of value in making high-lithium glass ply, thereby obtaining glass of increased toughness, especially for shapes can be cast directly.9/

Another method for the recovery of lithium from spodumene has been oped by the Bureau. By adapting the chloride volatilization process, it found possible to extract lithium in the form of chloride from a spodumene ntrate. Limestone and calcium chloride are mixed with the spodumene and mixture heated in a rotary kiln to at least 1100°C., permitting 95 to 98 ent volatilization of the lithium. A Cottrell precipitator will catch the um chloride fume from the partly cooled gases. The residue, if fired to ering temperature, is a white portland cement. This work on making low- e spodumene ores available to the lithium industry is now complete and be published shortly as a Report of Investigations under the title, oride Volatilization of Lithium from Spodumene", by Foster Fraas and . Ralston.

The investigations on this mineral have been gratifying in that two sfactory recovery methods are now available.

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raas, Foster, and Ralston, O.C., Beneficiation of Spodumene by Decrepitation: Report of Investigations 3336, Bureau of Mines, 1937, 13 pp.

Original from THE OHIO STATE UNIVERSITY

Talc

, At present, most "pure" talc is imported from France, Spain, and Italy, and a satisfactory domestic source is in growing demand. Certain talcs in northern New York are mixtures of two components of nonuniform proportions. An investigation is now in progress in cooperation with the industry to separate the "tremolite" component from the "talc" and to standardize on uniform proportions of these two components. The investigation has already shown that the talc is readily separated by froth flotation. It differs, however, from the usual froth-flotation problem, in that the talc is readily floated. Whereas, the usual problem is to find a suitable reagent to float the one component, the difficulty here is to avoid flotation of the tremolite. Considerable progress is being made, and it is hoped that the results will be ready for publication within the next few months.[10]

Kyanite

This mineral, which withstands high temperatures and has other qualities that make it suitable for refractory manufacture, has been used in increasing quantities during the past few years. The kyanite deposits in the Southeastern States almost invariably contain large quantities of impurities, especially iron, and much difficulty has been encountered in devising processes satisfactory for the recovery of a commercial grade. Bureau studies have shown that, with certain modifications, the most generally applicable process of concentration is froth flotation. Recent tests using reagents of the oleate type, especially a crude form of soap, have been quite successful. Agglomerate tabling has also been found of great value for certain simpler or For this work, only ore coarser than 100-mesh and smaller than about 20-mesh is adaptable. Any flotation collector that films the kyanite selectively may be used and followed by addition of about 1 percent of fuel oil to bring about agglomeration of the wet pulp. On passing over a concentrating table the large feathery floccules are carried off in the cross water. Exceedingly high grade concentrates of kyanite have been prepared in this simple manner. A year ago the industry thought it wanted an important amount of its kyanite in coarse pieces to make grog for ceramic shapes. The coarse grog was to mak up the backbone of the structure, its interstices to be filled with finer grog, and finally a binder of refractory clay to be used to fill the small voids. It has now become increasingly apparent that most kyanites are too weakened by heating through their inversion temperature into mullite, and the chalky material is not strong enough to make grog. An increasing use of finely divided kyanite is now developing. This favors the use of froth flotation for concentration.

The Nonmetallics Station has been working on the adaptation of raw kyani to the demand for grog. Under 4 percent addition of magnesia to a pure, fine divided kyanite causes it to knit together densely and with little loss in melting point, so that the fired bats can be crushed up into coarse, dense gr However, 4 percent magnesia leaves the material subject to heat shock and spalling. Lesser amounts demand higher temperatures of firing. Another is to use a certain amount of precalcined kyanite fines, which expand on heating, to mix with raw kyanite fines, which expand greatly ersion, and a small amount of bond clay which shrinks considerably, ulting mix having little change in dimension on firing. This material n suitable for use as grog, or shapes can be made of this mix direct, t any further work than molding them before firing. Such a material could e used to advantage in a ramming mix for lining furnaces. In industries high resistance to slagging action is needed, as in glass melting, aterials should also be suitable. When our ordinary American kyanites een adapted in some such way as the above, to compete with imported kyanite which does not weaken so greatly on first calcination, the for American kyanite should be much larger. All Indian kyanite is now precalcined, crushed and sized and made up into grog bodies and fired in the final shapes.11/

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[10] Clemmer, J. B. and Cooke, S. R. B., Flotation of Vermont Talc-Magnesite Ores: Report of Investigations 3314, Bureau of Mines, 1936, 12 pp.

Removal of Iron from Nonmetallic Minerals

he results of the kyanite investigations on removing attached iron from allic minerals have been highly encouraging and should be applied to minerals. In many cases, undesirable iron stains will impair the y of otherwise useful minerals, including glass, sands, feldspar, e, clay, barite and spodumene. In order to render them marketable and crease the necessity of getting pure minerals from different points, it ieved highly desirable that provision be made for extending these igations. By so doing, the necessity of importing them from Europe l be reduced. White clay is needed for paper making and lithium minerals le for production of very tough glass must be low in iron.

Clay

he mineralogy of clay has been obscure, and few mineralogists know o deal with ordinary, finely divided clays. The past 10 years has seen sive application of X-ray crystallography to clays, with the result e now know that clays vary according to the clay minerals present, their distribution, and their contamination by minerals that are not true minerals. The only means of separating clays into fractions has been imentation methods, which tend to separate fines from coarse.

he possibility of froth flotation in connection with the preparation ays for ceramic use was undertaken in cooperation with the Tennessee y Authority to determine whether local domestic clay might be utilized he manufacture of porcelain ware. A great deal of the procelain used e United States is imported because of the supposed absence in this country tisfactory clay from which to manufacture porcelain. Except for the ce of mica and other deleterious constituents, certain of these local ic clays might be satisfactory. New reagents for collecting minerals eeded, but after developing them the work was simplified. It is possible

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O'Meara, R. G. and Gandrud, B. W., Concentration of Georgia Kyanite Ore; Am. Inst. Min. and Met. Eng. Contrib. 98, 1936, 3 pp.

first to float off the colloidal matter, which in this instance is mainly halloysite; second, the more granular kaolinite concentrate; next, a semiclay mineral, of granular characteristics, called hydromica and probably actually a sericite of low alkali-metal content; then, the fine, unweathered mica; th the fine quartz; and finally, the feldspar in the mixture is left. These flotation tests, using suitable reagents, resulted in a good separation of th clay from undesirable impurities, although certain difficulties in the manipulation during the casting of the mold have been reported.

These favorable results, which should have possibilities in connection with clays for various purposes, indicate that it is a new development in cla preparation. They have also shown that a real need exists for better America clays. Imports of special clays total over 200,000 tons during our worst depression years and rise to nearly one-half million tons in times of prosper American clays are mixtures of several clay minerals and finely divided extraneous minerals. As a rule, the clay minerals are in the wrong proporti for best utilization.

The Bureau of Mines has applied a new tool to clay fractionation. It is froth flotation, which in the past has been used only for removing discolorin impurities. The results on two clays tested in a preliminary way show that it is possible to prepare fractions of a clay that are ceramically very different. By recombining some of the fractions in more desirable proportio better wet-working and burning characteristics are obtained. This separatio gives a means of control that was previously lacking and was remedied only b using clays from a wide variety of sources and often from distant points.

Flotation Applied to Other Minerals

The flotation reagents that worked well on clays had shown unusual beha on the mica, quartz, and feldspar in these clays, so a small amount of work been done on quartz-feldspar mixtures and mica mixtures with each. Whereas flotation separation of feldspar-quartz mixtures in the past has resulted in flotation of feldspar away from quartz, this new style of reagent floats qua in the presence of feldspar. Due to dwindling supplies of high-grade feldsp in the Appalachian East, such a separation is of great importance, and a patent application has been placed with assignment to the Secretary of the Interior as custodian for the public.

Ground mica, as fractionated by flotation, is also of interest. It is possible to obtain mica fractions of very low density per cubic foot - a des able characteristic. It is also possible, by this method, to eliminate grit materials (quartz and feldspar) very simply. Agglomerate concentration meth as mentioned above in connection with kyanite, have also been initiated and found applicable, at least to some of these mixtures. The field is attracti and now that we, seemingly, have a satisfactory set of mineral-filming agent the application of flotation and agglomeration in this field should be pushe rigorously.

It is hoped that this application of froth flotation and table agglomera- on can also be extended to a number of other minerals that now are mined only en found sufficiently pure. The diatomites, the pyrophyllites, the pumicites, e gypsites, and other minerals, when occurring as finely divided materials, e usually contaminated and disregarded in spite of their great abundance and oseness to markets.

Sizing of Powders

An air elutriator developed by the Bureau to separate powder into several es with considerable precision has been applied to the separation of powdered metallic materials in connection with research on ground talcs, pyrophyllites, ents, and other nonmetallics.

Another method of sizing and separating particles has been recently scovered, which utilizes their tendency to polarize electrically during heating cooling. This method of separating, which for convenience may be called oelectric separation, has been applied to the removal of mica from beach d in California. It is entirely possible that other applications of this nciple may be expected. For example, a method for the separation of feldspar m quartz (other than by handpicking) has been needed for many years. nite manufacturers also need a method of freeing coarse particles of pure nite from contaminating quartz and other minerals. At present, the only isfactory grade of kyanite for most purposes is that brought from India. eparation such as that referred to above might place the American product a comparable basis.

Barite

This mineral is now used extensively in the manufacture of paint, both ground barite and for making lithopone. It is also used for making barium micals and as a mineral filler. As the domestic sources are limited, much the present supply is being imported. The Southeastern States have many ttered and rather low-grade deposits of limited tonnage which would require atment to be utilized.

The three available types of ore include (1) high-iron ores of the etwater (Tenn.) district (2) high-silica ores of the Kings Creek (S.C.) trict (3) the ores of Bibb County (Ala.) contaminated with calcium fluoride d calcium carbonate.

Recently completed work shows that excellent removal of impurities is sible on the first two types of ores by means of froth flotation. For tain purposes, the third type can also be cleaned and utilized as a filler for the pigment trade where the color is not objectionable.[12]

O'Meara, R. G., and Coe, G. D., Flotation of Southern Barite Ores: Am. Inst. Min. and Met. Eng. Tech. Pub. 678, 1936, 6 pp.

III. PROCESSING AND UTILIZATION

Many nonmetallic minerals are available in relatively pure form and in large amounts. Investigation of suitable methods of utilization can result i great benefits and several such problems are now in progress.

Retardation of Portland Cement

A study of the factors involved in the retardation in the rate of settin of portland cement is important both to cement manufacturers and to those in ested in gypsum or anhydrite. Recently, a long research on the possibility of substituting anhydrite ($CaSO_4$) for gypsum ($CaSO_4 \cdot 2H_2O$) in the retarding o set of portland cement has been completed. A certain permissible substitutio was found and the results will be forthcoming in a technical paper to be published later. One important byproduct of this work was the discovery tha the water vapor distilling out of the gypsum has an important effect. Omitting gypsum entirely and substituting steam seasoning at temperatures common to clinker-grinding ball mills (in the range 105°-120°C.) the resultin ground cement is actually improved in many of its properties. Perfect contr over the rate of set can be obtained through a function of the temperature o seasoning by regulation of the amount of water vapor absorbed. The higher the temperature, the less water vapor the cement can take up. Cements have always been steam-seasoned unwittingly in the past and under imperfectly designed conditions, due to the water content of gypsum. Therefore, this wo has added an important new element of control over properties of portland cements. In addition, it makes possible a clinker ground to a finer degree, with a resulting cement of higher strength. The manuscript describing these results has been completed and will be published early in 1937 as a Bureau o Mines Technical Paper.13/

Pozzuolanic Minerals

In making a mortar or cement, the expansion or contraction during setti (usually caused by lime) is highly important and for many purposes, it is desired that this change in volume be kept to a minimum. The old Roman pozz cements were excellent in these qualities and recently, on the West coast, t pozzuolanic minerals have been used successfully, especially as part of the concrete mix in large structures. In these cases, lime is taken up as fast it is liberated from the hydration of the cement, thus causing little diffic In the present program of the Bureau, it is proposed to study the preparatio of better pozzuolanic minerals by processing those that are cheaply available but not sufficiently active, rather than by making a comparison of available ones. The first step in the investigation has been to study the interaction of representative minerals with lime solutions in a dilatometer where volume changes indicate the approach toward completion of the reactions. In additi X-ray studies, measurements of the conductivity and plasticity of various mixtures are also being made to correlate the various properties of these pozzuolanic materials.

13/ Roller, Paul S., Seasoning of Portland Cement at Elevated Temperature: Ind. and Eng. Chem., vol. 28, March 1936, pp. 362-369.

Hydration of Lime

The characteristics of the limestone from which mortar is made have an portant bearing on the manner of hydration. The plasticity of the resulting rtar is highly important, yet little is known about the factors that make r desirable characteristics. A study of changing composition of the limeone as it affects the hydration of lime is now in progress. Physical tests plasticity, rates of setting, and putty volume are being considered with ecial attention to temperature. The results, to date, show that plasticity very decidedly a factor of slaking temperature, and this temperature pends upon the magnesia content of the original limestone. For example, lomitic (magnesia) limes are improved in most cases by decreasing the free gnesia present. These studies are now nearing completion, and a manuscript scribing the characteristics of limes produced from various limestones ould be ready within the next few months.

Potash

For the past several years, an investigation has been in progress to termine satisfactory methods for the extraction of potash from polyhalite. e reduction process was studied in some detail and the investigation has w been concluded.[14, 15]

Cheap Electric Power

With increased interest in the utilization of low-cost hydroelectric er, many nonmetallic minerals justify attention. The bleaching of clay "electrodialysis" has been shown in the laboratory to be an effective y of obtaining good-quality clay. The most important cost factor is the er requirement. This treatment, which is electropurification of a nontallic material, can be applied even to common brick clay. It offers a eld that justifies considerable investigation, and by cooperation with er agencies at present engaged in investigations relating to utilizing ectric power the nonmetallic mineral industry can look for several new velopments.

Fraas, Foster, and Partridge, Everett P., Potash from Polyhalite by Reduction Process. Extraction of Potassium Sulphide and the Production of Potassium Carbonate: Ind. and Eng. Chem., vol. 28, 1936, pp. 224-229.

Fraas, Foster, and Partridge, Everett P., Potash from Polyhalite by Reduction Process, III.: Ind. and Eng. Chem., vol. 28, 1936, pp. 956-962.

IV. NEW FACILITIES FOR NEW PROBLEMS

A significant development during the last year was the completion of a new building at Tuscaloosa, Ala., in which the Bureau of Mines laboratories and offices are now located. An allotment was made available by the Public Works Administration for constructing and equipping the Bureau of Mines building, and a site for the building was granted to the Federal Government by the University of Alabama. The building was completed in the early spring and formally dedicated on May 26, 1936. It is a modern, well-equipped laboratory building and affords ideal physical facilities for the research work on the nonmetallic minerals of the South.

A similar building is now under construction at College Park, Md., to house the activities of nonmetallic investigations in the East and should be completed in the early spring of 1937.

With the completion of these two new buildings, increased facilities now are available for conducting research on nonmetallic mineral technology. In addition to the problems on which work is now in progress, several others deserve attention, and the following could well be included in the program of the Bureau:

The bleaching-clay industry has been growing and improving by leaps and bounds. Bentonite (or rather montmorillonite), the active mineral in bentonite rock, is the principal raw material. Due to distances of sources of bentonite it is highly desirable to find out how to synthesize montmorillonite from other more local clay minerals.

Feldspathoid minerals of higher alumina content than ortho-clase are wanted by the glass industry. Nephelite is such a mineral, and nephelite syenites occur in the eastern United States where the material is wanted. A study of the mineralogical characteristics of the nephelite syenites shoul be vigorously prosecuted, and then a number of separating methods can be devised.

Recent discovery of the effect of some materials in reducing grinding power, even when added in vanishingly small amounts to materials needing grinding, calls attention to the need of study of "grinding aids".

Improvement in mineral fillers by filming them with organic surface modifiers for producing dispersion in air, dispersion in liquids, improving wettability, or bringing about water repellance is a study which is similar to the use of flotation collecting and frothing agents and which can be conducted from that basis.

Sand-blast mineral grains from specially treated minerals like garnet, corundum, flint, and others of that nature are capable of considerable impro ment. Similar modification of grains of minerals so that they give better sand for sand paper is next in order. The abrasive properties of our various pumices and pumicites, tripolis, and quartz sands add to the above to show that research on natural abrasives and polishing minerals would be well-justified.